CLAIMS

What is claimed is:

1. A laser apparatus, comprising

(a) a gain medium emitting a light beam;

(b) a wavelength selection element positioned in said light beam; and

(c) a non-reciprocal pickoff positioned in said light beam.

2. The laser apparatus of claim 1, wherein said non-reciprocal pickoff comprises:

(a) a linear polarizer positioned in said light beam between said gain medium and said wavelength selection element; and

(b) a non-reciprocal polarization rotator positioned in said light beam between said linear polarizer and said wavelength selection element.

3. The laser apparatus of claim 2, wherein said non-reciprocal pickoff further comprises a reciprocal polarization rotator positioned in said light beam between said linear polarizer and said wavelength selection element.

4. The laser apparatus of claim 2, wherein said gain medium and said linear polarizer are angularly positioned with respect to an said non-reciprocal polarization rotator at an angle that is substantially equal to an angle of rotation defined by said non-reciprocal rotator.

5. The laser apparatus of claim 3, wherein said non-reciprocal polarization rotator and said reciprocal polarization rotator are balanced with respect to each other.

6. The laser apparatus of claim 3, wherein said non-reciprocal polarization rotator and said reciprocal polarization rotator each define substantially equal angles of polarization rotation.

7. The laser apparatus of claim 1, further comprising an end reflector positioned in said light beam after said wavelength selection element, said end reflector and a reflective facet of said gain medium defining an external laser cavity.

8. The laser apparatus of claim 1, wherein said wavelength selection element comprises a grating.

9. The laser apparatus of claim 1, wherein said wavelength selection element comprises an etalon.

10. The laser apparatus of claim 2, wherein said wavelength selection element is angularly positioned with respect to an said non-reciprocal polarization rotator at an angle that is substantially equal to an angle of rotation defined by said non-reciprocal rotator.

11. The laser apparatus of claim 1, wherein said wavelength selection element is tunable.

12. A laser apparatus, comprising:

(a) a gain medium having first and second facets, said gain medium emitting a light beam from said first facet along an optical path;

(b) a wavelength selection element positioned in said optical path and configured to feed back light to said gain medium;

(c) a reflector positioned in said optical path after said wavelength selection element, said reflector and a facet of said gain medium defining an external laser cavity; and

(d) a non-reciprocal pickoff positioned in optical path before said wavelength selection element.

13. The laser apparatus of claim 12, wherein said non-reciprocal pickoff comprises:

(a) a linear polarizer positioned in said optical path before said wavelength selection element; and

(b) a non-reciprocal polarization rotator positioned in said optical path after said linear polarizer and before said wavelength selection element.

14. The laser apparatus of claim 13, wherein said non-reciprocal pickoff further comprises a reciprocal polarization rotator positioned in said optical path after said linear polarizer and before said wavelength selection element.

15. The laser apparatus of claim 14, wherein said gain medium and said linear polarizer are angularly positioned with respect to said non-reciprocal polarization rotator at an angle that is substantially equal to an angle of rotation defined by said non-reciprocal polarization rotator.

16. The laser apparatus of claim 14, wherein said non-reciprocal polarization rotator and said reciprocal polarization rotator are balanced with respect to each other.

17. The laser apparatus of claim 14, wherein said non-reciprocal polarization rotator defines an angle of polarization rotation substantially equal to that of said reciprocal rotator.

18. The laser apparatus of claim 13, wherein said wavelength selection element is angularly positioned with respect to an said non-reciprocal polarization rotator at an angle that is substantially equal to an angle of rotation defined by said non-reciprocal rotator.

19. The laser apparatus of claim 12, wherein said wavelength selection element comprises a grating.

20. The laser apparatus of claim 12, wherein said wavelength selection element comprises an etalon.

21. The laser apparatus of claim 13, wherein said linear polarizer comprises a polarizing beam splitter.

22. The laser apparatus of claim 13, wherein said non-reciprocal polarization rotator comprises a Faraday rotator.

23. The laser apparatus of claim 12, wherein said wavelength selection element is tunable.

24. A method of laser operation, comprising:

(a) emitting a light beam from a gain medium along an optical path;

(b) positioning a wavelength selection element in said optical path;

(c) positioning a non-reciprocal pickoff in said optical path between said gain medium and said wavelength selection element;

(d) feeding light back to said gain medium by said wavelength selection element; and

(e) picking off, by said non-reciprocal pickoff, a portion of light traveling said optical path from said wavelength selection element towards said gain medium.

25. The method of claim 24, wherein said positioning said non-reciprocal pickoff comprises:

(a) positioning a polarization-dependent beam splitter in said optical path between said gain medium and said wavelength selection element; and

(b) positioning a non-reciprocal polarization rotator in said optical path between said polarization-dependent beam splitter and said wavelength selection element.

26. The method of claim 25, further comprising angularly positioning said polarization-dependent beam splitter and said gain medium with respect to each other at an angle that is substantially equal to the angle of polarization rotation defined by said non-reciprocal polarizer.

27. The method of claim 25, wherein said positioning said non-reciprocal pickoff further comprises positioning a reciprocal polarization rotator in said optical path between said polarization-dependent beam splitter and said tunable element.

28. The method of claim 24, further comprising positioning a reflector in said optical path after said wavelength selection element.

29. The method of claim 28, further comprising defining an external laser cavity between said reflector and a reflective facet of said gain medium.

30. The method of claim 24, further comprising tuning said wavelength selection element to select wavelength of said light fed back to said gain medium.

31. A method for generating spectrally clean laser output, comprising:

(a) emitting a light beam from a gain medium outward along an optical path;

(b) allowing said outward light beam to interact with a tunable element;

(c) returning a spectrally cleaned light beam along said optical path to said gain medium from said tunable element; and

(d) non-reciprocally picking off a portion of said returning, spectrally cleaned light beam from said optical path and directing said portion along an output path.

32. The method of claim 31, wherein said non-reciprocally picking off comprises:

(a) passing said outward light beam through a linear polarizer;

(b) passing said outward light beam through a non-reciprocal polarization rotator and a reciprocal polarization rotator;

(c) passing said returning, spectrally cleaned light beam through said non-reciprocal polarization rotator and said reciprocal polarization rotator; and

(d) picking off said portion of said returning, spectrally cleaned light beam by said linear polarizer.

33. The method of claim 32, wherein said passing said outward light beam through said non-reciprocal polarization rotator and said reciprocal polarization rotator comprises:

(a) rotating, by said non-reciprocal polarization rotator, polarization orientation of said outward light beam by an amount equal to θ; and

(b) rotating, by said reciprocal polarization rotator, said polarization orientation of said outward light beam by an amount equal to $-\theta$.

34. The method of claim 33, wherein said passing said returning, spectrally cleaned light beam through said non-reciprocal polarization rotator and said reciprocal polarization rotator comprises:

(a) rotating, by said reciprocal polarization rotator, polarization orientation of said outward light beam by an angle θ; and

(b) rotating, by said non-reciprocal polarization rotator, said polarization orientation of said outward light beam by an angle θ.

35. The method of claim 34, wherein said linear polarizer comprises a polarizing beam splitter.

36. The method of claim 33, further comprising defining said reciprocal polarization rotator by angularly orienting said gain medium and said polarization-dependent beam splitter with respect to each other by a selected angle.

37. A laser apparatus, comprising

(a) gain means for emitting a light beam along an optical path;

(b) means for tuning said light beam positioned in said optical path; and

(c) means for non-reciprocally picking off a portion of light returning from said tuning means to said gain means, said non-reciprocally picking off means positioned in said optical path between said gain means and said tuning means.

38. The laser apparatus of claim 37, wherein said non-reciprocally picking off means comprises:

(a) means for linearly polarizing said light beam polarization-dependent beam splitter positioned in said light beam; and

(b) means for non-reciprocally rotating polarization orientation of said light beam positioned in said light beam after said linearly polarizing means.